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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : 10/717,299 Confirmation No.: 6479
Applicant: : Srinivas et al.
Filed: : November 19, 2003
Group Art Unit : 1754
Examiner: : Hertzog, Ardith E.
For: PROCESS FOR THE SIMULTANEOUS REMOVAL OF SULFUR AND MERCURY

Docket No. : 144-02
Customer No. : 23713

DECLARATION OF GIRISH SRINIVAS

I Girish Srinivas, declare that:

I am a co-inventor of the above-identified application. I have a doctoral degree in Chemical Engineering and have worked in the field of catalysis and chemical processing for over 16 years. I am also a co-inventor of U.S. 6,099,819 which has been cited in rejections of the claim of the above-identified application. For the past 12 years I have been employed at TDA Research, Inc. the assignee of record of the current application as well as the '819 patent.

The invention in the above-referenced application relates to methods for simultaneous removal of hydrogen sulfide and mercury from gas streams containing these species. The method as claimed in claim 1 involves contacting the gas stream with a mixed metal oxide catalyst at certain temperatures in the presence of oxygen to oxidize hydrogen sulfide to sulfur and condensing the sulfur out of the gas stream such that mercuric sulfide is formed and also condensed with the sulfur.

I have reviewed the Office Action issued in the above-referenced application in which claims are rejected as unpatenable over U.S. Patent 6,099,819 and U.S. Patent 4,786,483 (Audeh). U.S. Patent 6,099,819 teaches the use of certain mixed metal catalysts for the oxidation of hydrogen sulfide to sulfur in gas streams in the presence of oxygen. The Audeh patent is said in the Office Action to demonstrate that "some natural gas fields yield natural gas

containing both hydrogen sulfide and mercury." The claims are rejected as stated in the Office Action because "one or ordinary skill in the art would have been motivated to treat" gas containing both hydrogen sulfide and mercury "when having utilized the '819 process to treat natural gas, thereby simultaneously removing sulfur and mercury."

First, while mercury is a known contaminant of certain natural gas streams (as well as in many hydrocarbon gas streams generated by coal gasification), mercury is not present in all such gas streams. It is further my experience and training that a researcher or engineer in this field would not apply a process such as the process of '819 patent to a gas stream without considering the possible affect of other contaminants in the gas stream, such as mercury, on the process. The '819 patent itself does not consider the potential affect of the presence of mercury in the gas stream on the process or the catalysts employed.

Sometime after the invention of the '819 process, we undertook a project which involved treatment of gas streams containing both hydrogen sulfide and mercury and considered application of the method of the '819 patent. In considering this project, we (my co-inventor and I) were initially concerned that at the temperatures of the '819 process that the catalysts would be rapidly deactivated or fouled because mercury could react with sulfur to form mercuric sulfide which we expected would condense onto the catalyst. The possible condensation of sulfur onto the catalyst had been a significant concern during the development of the '819 process. As indicated in that patent, process temperatures were adapted to avoid sulfur condensation on the catalyst. On further consideration of the complex system, we could not be sure in view of the conditions of the '819 process for formation of sulfur, how much mercuric sulfide would form in the system and where in the system it would condense. Any significant condensation on the catalyst would very likely make the process useless in any practical sense. Further, we could not determine whether or not mercuric sulfide formation and condensation would be sufficiently efficient to lower the mercury to acceptable levels. One solution to the mercury problem that

we initially considered was removal of mercury prior to application of the '819 process, for example employing adsorbents known in the art.

We understood however that a single step process that would remove both contaminants would have considerable benefits and thus further investigated the possible fate of mercury in our process. Because of the complexities of the reaction system involved, we performed modeling studies on our processing system as a function of temperature, gas pressures and gas stream composition. We were encouraged that these studies indicated that mercuric sulfide would not condense in the catalyst bed, but instead would co-condense with the sulfur. We followed these modeling studies with experiments employing gas streams containing both sulfur and mercury. These experiments demonstrated that mercuric sulfide did in fact co-condense with sulfur and further that we were able using catalysts of the '819 patent to decrease the level of mercury in the gas stream to acceptably low levels. In fact, we demonstrated greater than 95% removal of mercury in such gas streams which is as good as or better than results obtained with absorbents for mercury removal known at the time.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-referenced application or any patent issuing thereon.

12/08/05
Date

Girish Srinivas